Specification

Title of the Invention

Organic Electroluminescent Device and Manufacturing Method Therefor

Background of the Invention

1. Field of the Invention

The present invention relates to organic electroluminescent devices which are electrical device light emitting devices used for displays, light sources for displays, and the like, and to manufacturing methods therefor.

2. Related Art

Recently, as self-luminous displays in place of liquid crystal displays, development of light-emitting devices (organic electroluminescent devices, hereinafter referred to as organic EL devices), which have a structure in which a light-emitting layer composed of an organic material is provided between an anode and a cathode, has been advancing rapidly. Among these, a high-transmission EL device, a so-called transparent EL device (TOELD) used in the visible light region, which can emit light from the two electrode sides, has been desired since overlapped displays can be performed by disposing another display device thereunder, and a particular structure is proposed in, for example, Appl. Phys. Lett. 68(19), 6 May 1996, p 2606.

In the paper mentioned above, it is disclosed that an aluminum complex Alq3, which is a low molecular material, is used as a light-emitting layer, a cathode is formed by co-deposition of Mg and Ag, an ITO film is formed by sputtering thereon for sealing or for assistance to the cathode so as to form a device, and a threshold voltage of approximately 8 V is achieved. In the structure described above, in view of the life and the threshold characteristics of a material used for the light-emitting layer, Mg and Ag are used for the cathode, and in addition, ITO is used for the upper layer thereon.

Concerning organic EL devices, it is proposed that a light-emitting material having a low threshold value is used for a light-emitting layer, and a metal material having a low work function is used for a cathode so as to realize operation at a low threshold voltage. However, in the structure proposed in the paper described above, Mg and Ag are not sufficient in view of the work functions, and since ITO is additionally deposited on the metal material by sputtering in order to prevent the degradation thereof, Mg is oxidized, whereby a problem may arise in that an increase in threshold voltage of the device cannot be finally avoided.

Summary of the Invention

The present invention was made in consideration of the problem described above, and an object of the present invention is to provide an organic electroluminescent device which can be operated at a low voltage and which has high efficiency, high transmission characteristics, and a

long life, and is to provide a manufacturing method therefor.

According to the present invention, an organic EL device is provided, which comprises an anode , a light-emitting layer composed of an organic material, and a cathode which has a structure in which a first cathode composed of a material having a work function of 3.0 eV or less and a second cathode composed of a material having a work function higher than that of the first cathode are sequentially stacked from the light-emitting layer side and the total thickness of the first and the second cathodes being 100 angstroms or less are stacked on a substrate and light is emitted to the outside via at least the cathode.

In addition, according to the present invention, a method for manufacturing an organic electroluminescent device is provided, which comprises the steps of; forming an anode on a substrate; forming a light-emitting layer composed of an organic material above the anode; and forming a cathode above the light-emitting layer by laminating a first cathode composed of a material having a work function of 3.0 eV or less and a second cathode composed of a material having a work function higher than that of the first cathode from the light-emitting layer side so that the total thickness of the first and the second cathodes is 100 angstroms or less.

Brief Description of Drawings

Fig. 1 is a cross-sectional view showing an device structure of an organic EL device according to an embodiment of the present invention.

Fig. 2 is a view showing a transmission spectrum in the visible